PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2001-143236

(43)Date of publication of application : 25.05.2001

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(51)Int.Cl. G11B 5/66
G11B 5/65
G11B 5/85

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(54) MAGNETIC RECORDING MEDIUM AND ITS MANUFACTURING METHOD

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a magnetic recording medium having excellent corrosion resistance even if the thickness of a magnetic layer is reduced and capable of sure reproduction using a MR head.
SOLUTION: The magnetic recording medium having the magnetic layer film-formed on at least, one principal surface of a non-magnetic substrate is characterized in so that the product Mr/t of the residual magnetization Mr of the magnetic layer and the thickness t of the magnetic layer is 26 mA or less.

LEGAL STATUS [Date of request for examination] 08.03.2006
[Date of sending the examiner's decision of rejection]
[Kind of final disposal of application other than the examiner's decision of rejection or

application converted registration]
[Date of final disposal for application]
[Patent number]
[Date of registration]
[Number of appeal against examiner's decision of rejection]
[Date of requesting appeal against examiner's decision of rejection]
[Date of extinction of right]

CLAIMS

[Claim(s)]
[Claim 1] The magnetic-recording medium characterized by product Mr-t of the residual magnetization Mr of the above-mentioned magnetic layer and thickness t of the above-mentioned magnetic layer being 26mA or less in the magnetic-recording medium which has the magnetic layer of a nonmagnetic base material which comes to form membranes a metal magnetic material to a 1 principal-plane side at least.
[Claim 2] It is the magnetic-recording medium according to claim 1 which becomes depressed, and is characterized by for the value which, as for the above-mentioned nonmagnetic base material, it comes to form a minute projection in the principal plane of the side by which a metal magnetic material is formed, and is formed by the above-mentioned magnetic layer originating in the above-mentioned minute projection, and which broke the diameter of the impression concerned by the depth of the impression concerned being seven or more, and the depth of the impression concerned being 8nm or less while having.
[Claim 3] The magnetic-recording medium according to claim 1 characterized by thickness t of the above-mentioned magnetic layer being 75nm or less.
[Claim 4] The magnetic-recording medium according to claim 1 characterized by coming to form membranes a protective coat on the above-mentioned magnetic layer.
[Claim 5] The magnetic-recording medium according to claim 1 characterized by being used for the magnetic-recording system using the magneto-resistive effect mold

reproducing head.

[Claim 6] In the manufacture approach of the magnetic-recording medium which is made to deposit a magnetic particle and forms a magnetic layer in the 1 principal-plane side of the nonmagnetic base material which a longitudinal direction is run a nonmagnetic long picture-like base material, and runs a base material Make maximum of the include angle with the direction of a normal of one principal plane of the above-mentioned nonmagnetic base material to make into 65 degrees - 75 degrees, and the minimum value of the include angle with the direction of a normal of one principal plane of the above-mentioned nonmagnetic base material to make is made into 45 degrees - 60 degrees. The manufacture approach of the magnetic-recording medium characterized by carrying out incidence of the above-mentioned magnetic particle to one principal plane of the above-mentioned nonmagnetic base material.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] About the so-called metal magnetic-thin-film type of a magnetic-recording medium and its manufacture approach, especially this invention is used for the magnetic-recording system using the magneto-resistive effect mold reproducing head, and relates to a suitable magnetic-recording medium and its manufacture approach.

[0002]

[Description of the Prior Art] The so-called spreading type produced by applying the magnetic coating which made powder magnetic materials, such as oxide magnetism powder or alloy magnetism powder, distribute in binders, such as a vinyl chloride vinyl acetate copolymer, polyester resin, and polyurethane resin, and conventionally drying on a nonmagnetic base material as a magnetic-recording medium of magnetic-recording medium is used widely.

[0003] On the other hand, with the rise of the demand to high density record, the so-called metal magnetic-thin-film type which put metal magnetic materials, such as Co-nickel, Co-Cr, and Co, directly on the nonmagnetic base material by plating or vacuum thin film means forming (vacuum evaporation technique, the sputtering method, the ion plating method, etc.) of magnetic-recording medium is proposed, and attention is attracted.

[0004] This metal magnetic-thin-film type of magnetic-recording medium is excellent in coercive force, residual magnetization, a remanence ratio, etc., and since it does not need to mix the binder which is nonmagnetic material into that the thickness loss at the

time of record demagnetization or playback is small since it not only excels in the magnetic parametric performance in short wavelength, but thickness of a magnetic layer can be made very thin, and a magnetic layer, it has many advantages -- the pack density of a magnetic material can be raised and big magnetization can be obtained.

[0005] Furthermore, in order to raise the magnetic parametric performance of this kind of magnetic-recording medium and to enable it to obtain a bigger output, it faces forming the magnetic layer of a magnetic-recording medium, the so-called method vacuum evaporationo of slanting which vapor-deposits a magnetic layer to the method of slanting is proposed, and it is put in practical use as a magnetic tape for the object for high-definition VTR, and digital VTR.

[0006] By the magnetic-recording medium, when using it, for example for noncommercial digital VTR etc., in order to raise endurance and corrosion resistance, the protective coat by carbon etc. is formed on a magnetic layer further again.

[0007] On the other hand, also in this kind of magnetic-recording medium, the magnetic head (MR head) using a magneto-resistive effect component is increasingly used instead of the conventional induction type magnetic head in response to the request of the further formation of high density record in a renewal process. Generally, the MR head has the description which can detect the minute magnetic leakage flux from a magnetic-recording medium to high sensitivity.

[0008]

[Problem(s) to be Solved by the Invention] By the way, in this kind of magnetic-recording medium, in order to secure transit endurance, while the minute projection with a non-magnetic-material ball etc. is formed, the minute projection generated in the contingency in a production process and surface down stream processing exists in the front face of the nonmagnetic base material which forms a magnetic layer. If a ferromagnetic metal thin film is formed by the method vacuum evaporationo of slanting to the nonmagnetic base material of the shape of surface type which has such a minute projection, near the **** projection, by the self-shadow effect, the part which a vacuum evaporationo particle cannot reach easily will appear, and an impression will occur in a magnetic layer.

[0009] If an impression which was mentioned above to the magnetic layer exists in a sharp configuration, on the impression concerned, a protective coat may not be formed certainly. Thus, when a protective coat is not formed certainly but a magnetic layer attends the method of the outside of direct, the magnetic layer concerned will be put to the open air etc., and may be corroded. That is, there was a problem that it originated in the impression of a magnetic layer and desired endurance and corrosion resistance could not be acquired in a magnetic-recording medium.

[0010] Regulating the incident angle of a vacuum evaporationo particle in the more nearly perpendicular direction to a nonmagnetic support surface as an approach of forming the magnetic layer which has the front-face nature which did not make a

magnetic layer front face produce an impression, but was excellent in it is known. However, by this approach, un-arranging [that the magnetic properties of a magnetic layer will change sharply and will degrade a magnetic parametric performance] arises.

[0011] Moreover, by the magnetic-recording medium, it is possible by enlarging thickness of a magnetic layer to raise the endurance of a magnetic layer. However, in a magnetic-recording medium, when thickness of a magnetic layer is thickened, and the magnetic leakage flux from a magnetic layer expressed with product Mr-t of residual magnetization Mr and thickness t of a magnetic layer will become large and is reproduced by the MR head, a magneto-resistive effect component is saturated magnetically and there is a problem that a playback output cannot be obtained. Therefore, in a magnetic-recording medium, the corrosion resistance of a magnetic layer cannot be raised by making thickness of a magnetic layer into size.

[0012] Then, this invention is thought out in view of the conventional actual condition which was mentioned above, and it aims at offering a magnetic-recording medium certainly reproducible using an MR head, and its manufacture approach while it has the corrosion resistance which was excellent also considering the thickness of a magnetic layer as smallness.

[0013]

[Means for Solving the Problem] The magnetic-recording medium of this invention which attained the purpose mentioned above has the magnetic layer of a nonmagnetic base material formed at least at the 1 principal-plane side, and is characterized by product Mr-t of the residual magnetization Mr of the above-mentioned magnetic layer and thickness t of the above-mentioned magnetic layer being 26mA or less.

[0014] The magnetic-recording medium concerning this invention constituted as mentioned above can perform positive playback, without saturating a magneto-resistive effect component magnetically, even if it uses for a record regeneration system equipped with the magneto-resistive effect mold magnetic head in order to specify product Mr-t of the residual magnetization Mr of a magnetic layer, and thickness t to a predetermined value for example.

[0015] Moreover, it becomes depressed, and it is desirable [a magnetic-recording medium] that the value to which it comes to form a minute projection in the principal plane of the side by which the magnetic layer of a nonmagnetic base material is formed, and a magnetic layer is formed in the above-mentioned minute projection by originating and which broke the diameter of the impression concerned by the depth of the impression concerned is seven or more, and the depth of the impression concerned is 8nm or less while having.

[0016] Thus, by the constituted magnetic-recording medium, since the configuration of the impression formed in a magnetic layer front face is specified, for example, when a protective coat etc. is formed so that a magnetic layer may be covered, the protective coat concerned etc. can cover an impression certainly. For this reason, in this

magnetic-recording medium, what a magnetic layer becomes depressed and corrodes from a part can be prevented.
[0017] Moreover, the manufacture approach of the magnetic-recording medium concerning this invention which attained the purpose mentioned above It is the manufacture approach of the magnetic-recording medium which is made to deposit a magnetic particle and forms a magnetic layer in the 1 principal-plane side of the nonmagnetic base material which a longitudinal direction is run a nonmagnetic long picture-like base material, and runs a base material. It is characterized by carrying out incidence of the above-mentioned magnetic particle to one principal plane of the above-mentioned nonmagnetic base material, making maximum of the include angle with the direction of a normal of one principal plane of the above-mentioned nonmagnetic base material to make into 65 degrees - 75 degrees, and using the minimum value of the include angle with the direction of a normal of one principal plane of the above-mentioned nonmagnetic base material to make as 45 degrees - 60 degrees.
[0018] By the manufacture approach of the magnetic-recording medium of this invention constituted as mentioned above, in case incidence of the magnetic particle is carried out to one principal plane of a nonmagnetic base material, the include angle (incident angle) which the direction of incidence of a magnetic particle and the direction of a normal of one principal plane of a nonmagnetic base material make is specified. That is, the maximum and the minimum value of an incident angle are specified in the predetermined range. By this technique, by specifying the maximum and the minimum value of an incident angle, it can be made to take a desired columnar structure and the magnetic layer which has desired magnetic properties can be formed.
[0019]
[Embodiment of the Invention] Hereafter, the gestalt of suitable operation of the magnetic-recording medium concerning this invention and its manufacture approach is explained to a detail with reference to a drawing.
[0020] The magnetic-recording medium which applied this invention consists of a nonmagnetic base material 1, a magnetic layer 2 formed on the nonmagnetic base material 1, and a protective layer 3 formed on the magnetic layer 2, as shown in drawing 1 . Moreover, as a magnetic-recording medium by which this invention is applied, it is not limited to such a configuration, but with the field in which the magnetic layer 2 of the nonmagnetic base material 1 was formed, it may have the back coat layer in the field of the opposite side, or lubricant may be applied on a protective layer 3.
[0021] As long as the nonmagnetic base material 1 is used for this kind of magnetic-recording medium, what kind of ingredient may usually be used for it. As a nonmagnetic base material 1, plastics, such as cellulosics, such as polyolefines, such as polyester, such as polyethylene terephthalate, polyethylene -2, and 6-naphthalate, polyethylene, and polypropylene, and cellulose triacetate, a polycarbonate, polyimide, a

polyamide, and polyamidoimide, can be illustrated. Although thickness of the nonmagnetic base material 1 is usually set to about 3-10 micrometers, as long as the mechanical strength at the time of transit uses a high ingredient, it may be about 2-4 micrometers.

[0022] Moreover, minute projection 1a is formed on the nonmagnetic base material 1. This minute projection 1a is formed by well-known approaches, such as the approach of applying on a substrate the coating which distributed the particle in the solvent with the binder, a method of making a particle contain as a filler inside a substrate, or the approach of using these together. As a mark particle used for these approaches, mark particles, such as an organic macromolecule and an inorganic compound, are raised. SiO2 and TiO2 grade are raised as an inorganic compound. In addition, therefore, **** projection 1a may be formed on the 1 principal plane of the nonmagnetic base material 1 at a lithography technique using the approach and plating which form irregularity artificially on the nonmagnetic base material 1, and the approach of therefore forming the island-shape structure of a metal, an inorganic compound, or an organic macromolecule at vacuum thin film coating technology. As for the height of minute projection 1a, it is usually desirable that it is 5-50nm. As for especially minute projection 1a, it is desirable that it is smaller than the thickness of the magnetic layer 2 mentioned later. In addition, the height of **** minute projection 1a points out the thing of the height from the smooth front face where **** projection 1a of the nonmagnetic base material 1 does not exist to minute projection 1a. Moreover, to this minute projection 1a, it thinks also including the projection generated in the contingency in the process which produces the nonmagnetic base material 1.

[0023] A magnetic layer 2 is formed by technique, such as a vacuum deposition method, on the 1 principal plane in which minute projection 1a of the nonmagnetic base material 1 was formed. As a ferromagnetic metallic material which forms a magnetic layer 2, conventionally, a well-known metal or a well-known alloy is mentioned, and, specifically, ingredients, such as Co, CoNi, CoFe, CoNiFe, CoCr, CoCrPt, CoCrTa, and CoCrPtTa, can be illustrated. Moreover, a magnetic layer 2 may consist of the thing which comes to contain oxygen in the film or a thing which comes to contain the metal of one sort or two sorts of others in the above-mentioned ingredient, and a non-dissolving system magnetic layer which contained the existing ferromagnetic metal alloy of Co-aluminum 2O3 and CoPt-SiO2 grade further by forming the above-mentioned ingredient in an oxygen ambient atmosphere.

[0024] Product Mr-t of the residual magnetization [in / in especially this magnetic layer 2 / field inboard] Mr and the thickness of magnetic layer 2 self is prescribed to be set to 26mA or less. Especially the value of above-mentioned Mr-t is 5-26mA preferably. Moreover, at this time, when thickness t of magnetic layer 2 self becomes thick beyond the need, since a noise increases, 75nm or less is desirable and it is more desirable [t / the shape of surface type becomes less smooth / t /, and] that it is 30nm - 70nm.

[0025] Moreover, a nonmagnetic substrate layer may be formed on the nonmagnetic base material 1, and a magnetic layer 2 may be formed on the nonmagnetic substrate layer concerned. This nonmagnetic substrate layer is formed for the purpose of the improvement in adhesion force of a magnetic layer 2, improvement in the magnetic stacking tendency of a magnetic layer 2, and the corrosion-resistant improvement in a magnetic layer 2. As a nonmagnetic substrate layer, a compound with the alloy and oxygen which combined these besides metals, such as Co, Zr, Pt, Au, Ta, W, Ag, aluminum, Mn, Cr, Ti, V, Nb, Mo, and Ta, nitrogen, etc. is sufficient.

[0026] In case a magnetic layer 2 is formed, a vacuum evaporation system as shown in drawing 2 is used.

[0027] This vacuum evaporation system is constituted as the so-called object for the method vacuum evaporationo of slanting, and the source 13 of vacuum evaporationo for ferromagnetic metal thin films is arranged, and it becomes so that the interior may counter at this with the cooling can 12 which rotates in the direction of a counterclockwise rotation as it is cooled by about -20 degrees C and the drawing Nakaya mark A shows for example, in the 1x10 vacuum chamber 11 made into the vacuum which is about -3Pa.

[0028] Moreover, in this vacuum evaporation system, the supply roll 14 which rotates in the direction of a counterclockwise rotation in drawing, and the rolling-up roll 15 which rotates in the direction of a counterclockwise rotation in drawing are also arranged in the vacuum chamber 11, and after letting out the nonmagnetic base material 16 in the direction shown by the drawing Nakaya mark B from a supply roll 14 and running in accordance with the peripheral surface of the cooling can 12, it is rolled round by the rolling-up roll 15.

[0029] In addition, it rolls round with the cooling can 12 between a supply roll 14 and the cooling can 12, and guide rollers 17 and 18 are arranged between rolls 15, respectively, and a predetermined tension is applied to the cooling can 12 from a supply roll 14, and the nonmagnetic base material 16 rolls round from this cooling can 12 and it runs according to a roll 15, and it is made as [run / the nonmagnetic base material 16 / smoothly].

[0030] Ferromagnetic metallic materials, such as Co which was mentioned above in containers, such as crucible, are held, the above-mentioned source 13 of vacuum evaporationo is set to this vacuum evaporation system, and the electron beam generation source 19 for heating the ferromagnetic metallic material of this source 13 of vacuum evaporationo, and making it evaporate is also arranged. That is, it heats and this is evaporated, as the acceleration exposure of the above-mentioned electron beam generation source 19 to the electron beam 20 is carried out at the ferromagnetic metallic material of the source 13 of vacuum evaporationo and the drawing Nakaya mark C shows. Then, a ferromagnetic metallic material will be put on the nonmagnetic base material 16 it runs in accordance with the peripheral surface of the source 13 of vacuum

evaporationo, and the cooling can 12 which counters, and a ferromagnetic metal thin film will be formed on the nonmagnetic base material 16.

[0031] In addition, in the above-mentioned vacuum evaporation system, the 1st shutter 21 and 2nd shutter 22 are arranged between the source 13 of vacuum evaporationo, and the cooling can 12. While the 1st shutter 21 is located in the preceding paragraph side of the nonmagnetic base material it runs, the 2nd shutter 22 is located in the latter-part side of the nonmagnetic base material it runs. These 1st shutters 21 and the 2nd shutter 22 expose only a field predetermined [among the nonmagnetic base materials 1 it runs along with the principal plane of the cooling can 12] to the method of outside.

[0032] In addition, on the occasion of vacuum evaporationo of such a ferromagnetic metal thin film, oxygen gas is supplied near the front face of the nonmagnetic base material 16 through the oxygen gas inlet which is not illustrated, and improvement in the magnetic property of a ferromagnetic metal thin film, endurance, and weatherability can be achieved by this. Moreover, in order to heat the source of vacuum evaporationo, the means by which other, for example, resistance heating, means [means / by the above electron beams / heating], a high-frequency-heating means, a laser-heating means, etc. are well-known can be used.

[0033] Thus, in the constituted vacuum evaporation system, while evaporating a ferromagnetic metallic material from the source of vacuum evaporationo, the peripheral surface of a cooling can is run the nonmagnetic base material 1. In this vacuum evaporation system, the ferromagnetic metallic material which evaporated will be covered by the 1st shutter 21 and 2nd shutter 22, and will be deposited only on the nonmagnetic base material exposed to the method of outside from between the 1st shutter 21 and the 2nd shutter 22. Here, the 1st shutter 21 is arranged in the preceding paragraph side of the nonmagnetic base material it runs, and specifies the maximum incident angle among the evaporating ferromagnetic metallic materials. Moreover, the 2nd shutter 22 is arranged in the latter-part side of the nonmagnetic base material it runs, and specifies the minimum incident angle among the evaporating ferromagnetic metallic materials. At this time, an incident angle points out the include angle which the direction as for which the ferromagnetic metallic material which evaporated carries out incidence on a nonmagnetic base material, and the direction of a normal in the location as for which the ferromagnetic metallic material of a nonmagnetic base material carried out incidence make.

[0034] Concretely, in the vacuum evaporation system, while the 1st shutter 21 prescribes the maximum incident angle to 65-75 degrees, the 2nd shutter 22 has prescribed the minimum incident angle to 45-60 degrees. Thus, a vacuum evaporation system can be made into the columnar structure of a request of the magnetic layer 2 formed on the 1 principal plane of the nonmagnetic base material 1 by specifying the maximum incident angle and the minimum incident angle in the predetermined range.

[0035] Moreover, since this vacuum evaporation system makes it run a nonmagnetic

base material toward the 2nd shutter 22 side from the 1st shutter 21 side, it makes the ferromagnetic metallic material which evaporated deposit first on the nonmagnetic base material by the side of the 1st shutter 21. And the metal magnetic material with which the nonmagnetic base material took for running, and evaporated toward the 2nd shutter 22 side will carry out sequential deposition from the 1st shutter 21 side. For this reason, first, a metal magnetic material will be deposited on a nonmagnetic base material in the maximum incident angle, and, finally will finish being deposited in the minimum incident angle.

[0036] Thus, when forming a ferromagnetic metallic material and forming a magnetic layer 2, as shown in drawing 1 , impression 2a corresponding to minute projection 1a will be formed in magnetic layer 2 front face. In other words, impression 2a of magnetic layer 2 front face originates in minute projection 1a formed in one principal plane of the nonmagnetic base material 1, and is generated. If minute projection 1a is formed in one principal plane of the nonmagnetic base material 1 when performing slanting vacuum evaporationo, as mentioned above, a ferromagnetic metallic material will accumulate first on the minute projection 1a concerned. Then, with the ferromagnetic metallic material deposited on the minute projection 1a itself and minute projection 1a, while the so-called self-shadow effect is shown, a ferromagnetic metallic material accumulates. Thus, in order to form a ferromagnetic metallic material on the nonmagnetic base material 1 with which minute projection 1a was formed, impression 2a will be formed in magnetic layer 2 front face.

[0037] With the vacuum evaporation system shown in drawing 2 , as mentioned above, since the maximum incident angle and the minimum incident angle were specified, the value which broke the diameter (shown in [w] drawing 1 .) of impression 2a by the depth (shown in [d] drawing 1 .) of the impression 2a concerned can be made or more into seven, and depth d of the impression 2a concerned can be set to 8nm or less. As [form / namely, / in this magnetic layer 2 / sharp impression 2a / as / whose depth of less than 7 and impression 2a the value which broke the diameter w of impression 2a by depth d of the impression 2a concerned is size from 8nm]

[0038] Moreover, this magnetic-recording medium has the protective coat 3 formed on the magnetic layer 2. Concretely, as a protective coat 3, it is formed by forming ingredients, such as carbon, CrO2, aluminum2O3, BN, Co oxide, MgO, SiO2 and Si 3O4, SiNx, SiC, SiNx-SiO2, and ZrO2, TiO2, TiC, MoS. In case these ingredients are formed, a well-known membrane formation technique, for example, vacuum evaporation technique, the ion plating method, the sputtering method, a CVD method, etc. can be used.

[0039] It is desirable to use the carbon protective coat formed by the CVD method as a protective coat 3 especially. While the carbon protective coat formed by the CVD method is excellent in endurance or an anticorrosion property, it is excellent in productivity. Especially, according to the CVD method, it excels in the abrasion

resistance, corrosion resistance, and surface coverage which are called diamond-like carbon, and the hard carbon which has the shape of smooth surface type and high electrical resistivity can be formed on a magnetic layer.

[0040] Concretely, in case a carbon protective coat is formed, a carbon compound is disassembled in the plasma and membranes are formed on a magnetic layer. As a carbon compound, well-known ingredients, such as a hydrocarbon system, a ketone system, and an alcoholic system, can be used. Moreover, in order to decompose in the plasma, it is desirable to use high frequency bias voltage. Furthermore, it is desirable that Ar, H2, etc. are introduced as gas for promoting disassembly of a carbon compound at the time of plasma production. In order to raise more the film degree of hardness of a carbon protective coat, and corrosion resistance, after the carbon in a protective coat 3 has reacted with nitrogen, a fluorine, etc., you may exist in the state of [multilayer] a monolayer further again. In this case, it can consider as the condition of having mixed and the gas of N2, CHF3, or CH2F2 grade can be formed in a generate time for the plasma independent or by forming a carbon protective coat.

[0041] Moreover, as for the thickness of a protective coat 3, it is desirable that it is 4nm - 12nm. When the thickness of a protective coat 3 is less than 4nm, there is a possibility that abrasion resistance and corrosion resistance may deteriorate. On the contrary, when the thickness of a protective coat 3 is thicker than 12nm, loss by SUBESHINGU increases and there is a possibility that a magnetic parametric performance may deteriorate. When the CVD method mentioned above is used, by the thickness of 10nm or less, it is stabilized and a carbon protective coat can be formed.

[0042] By the way, by this magnetic-recording medium, as mentioned above, impression 2a formed in a magnetic layer 2 makes seven or more the value expressed by w/d, and d is regulated by 8nm or less. For this reason, a protective coat 3 will be formed so that impression 2a formed in the magnetic layer 2 may be covered certainly. In other words, a protective coat 3 is formed as film which continued on the magnetic layer 2 as did not become discontinuous on impression 2a.

[0043] The value as which impression 2a temporarily formed in a magnetic layer 2 is expressed in w/d is less than seven, or when d is the configuration which is size, impression 2a will become a sharp configuration and it will become what has the discontinuous protective coat 3 formed on the impression 2a concerned from 8nm. Therefore, as a magnetic-recording medium, the inflow of air, moisture, etc. will not be able to be prevented from the discontinuous part of a protective coat 3 in this case, but a magnetic layer 2 will be degraded. In this case, as for a magnetic-recording medium, corrosion resistance will deteriorate.

[0044] A magnetic-recording medium can raise corrosion resistance certainly by the protective coat 3 by regulating from this, impression 2a formed in magnetic layer 2 front face so that w/d may be seven or more and d may be set to 8nm or less. Moreover, by this magnetic-recording medium, since degradation of a magnetic layer 2 can be

prevented certainly, the fall of an output can be prevented and a magnetic parametric performance can be maintained. Especially, by this magnetic-recording medium, since product Mr-t of the residual magnetization Mr of a magnetic layer 2 and thickness t is 26mA or less, the fall of the magnetic parametric performance by degradation of a magnetic layer 2 will become remarkable, but since degradation of a magnetic layer 2 is prevented certainly, a predetermined magnetic parametric performance is certainly maintainable.

[0045] The magnetic-recording medium concerning this invention constituted as mentioned above can perform positive playback, without saturating a magneto-resistive effect component magnetically, even if it uses for a record regeneration system equipped with the magneto-resistive effect mold magnetic head in order to specify product Mr-t of the residual magnetization Mr of a magnetic layer 2, and thickness t to a predetermined value for example.

[0046] The thickness of a magnetic layer 2 can be controlled by changing line speed, and the amount of residual magnetization can be controlled by changing the amount of oxygen installation under membrane formation. By controlling these two parameters, MR reproducing head is not saturated and the maximum output is obtained in the condition that there is no distortion. When the value of Mr-t is size from 26mA, MR reproducing head is saturated and distortion arises.

[0047] Here, an MR head is the magnetic head only for playbacks which detects the signal from a magnetic-recording medium using a magneto-resistive effect. Generally, since sensibility is higher than the inductive mold magnetic head which performs record playback using electromagnetic induction and the playback output is large, the MR head is suitable for high density record. Therefore, high density record-ization can be attained more by using an MR head as the magnetic head for playback.

[0048] And this MR head is equipped with MR component section of the shape of an abbreviation rectangle pinched through the insulator by magnetic shielding of a pair which consists of soft magnetic materials, such as for example, a nickel-Zn polycrystalline ferrite. In addition, from the both ends of MR component section, the terminal of a pair is drawn and it is made as [supply / to MR component section / a sense current] through these terminals.

[0049] In case the signal from a magnetic-recording medium is reproduced using an MR head, a magnetic-recording medium is slid on MR component section. And where a magnetic-recording medium is slid on MR component section, through the terminal connected to the both ends of MR component section, a sense current is supplied to MR component section, and electrical-potential-difference change of the sense current concerned is detected. If a sense current is supplied to MR component section where a magnetic-recording medium is slid, according to the field from a magnetic-recording medium, the magnetization direction of MR component section will change and whenever [angular relation / of the sense current and the magnetization direction which

were supplied to MR component section] will change. And resistance will change depending on whenever [angular relation / which the magnetization direction of MR component section and the direction of a sense current make]. For this reason, electrical-potential-difference change will be produced on a sense current by making regularity the current value of the sense current supplied to MR component section. Then, by detecting electrical-potential-difference change of this sense current, the signal field from a magnetic-recording medium is detected, and the signal currently recorded on the magnetic-recording medium is reproduced.

[0050]

[Example] Hereafter, the concrete example which applied this invention is explained to a detail based on an experimental result.

[0051] a sample 1 -- the water-soluble latex which prepares a polyethylene terephthalate film with 6 micrometers [in thickness], and a width of face of 150mm, and uses acrylic ester as a principal component on this front face first -- a consistency -- 107 piece/mm2 It applied like and undercoat was formed.

[0052] Then, the metal magnetic thin film which consists of Co on undercoat was formed with vacuum deposition. In addition, the metal magnetic thin film was formed on the following membrane formation conditions.

[0053] membrane formation condition tape-feed rate: -- amount of 55 m/min oxygen installation: -- the time of 6.0x10-4m3 / min vacuum evaporationo -- degree of vacuum: -- 7x10 to 2 Pa, as a vacuum evaporation system, by using a thing as shown in drawing 2 , and adjusting the location of the 1st shutter 21 and the 2nd shutter 22, the minimum incident angle was made into 45 degrees, and the maximum incident angle was made into 70 degrees at this time.

[0054] Then, the carbon protective coat was formed about 10nm in thickness with the CVD method on the magnetic layer. And with the field in which the magnetic layer in a nonmagnetic base material was formed, while forming in the field of the opposite side the back coat layer which consists of carbon and urethane resin at the thickness it is thin 0.5 micrometers, the lubricant which consists of a perfluoro polyether was applied to the carbon protective coat front face, after that, it judged to 8mm width of face, and the magnetic tape was completed.

[0055] In sample 2 membrane-formation conditions, the magnetic tape was produced like the sample 1 except having made the tape-feed rate into 60 m/min, and having made the maximum incident angle into 75 degrees.

[0056] In sample 3 membrane-formation conditions, the magnetic tape was produced like the sample 1 except having made the tape-feed rate into 60 m/min, and having made the maximum incident angle into 60 degrees.

[0057] In sample 4 membrane-formation conditions, the magnetic tape was produced like the sample 1 except having made the tape-feed rate into 60 m/min, and having made the maximum incident angle into 80 degrees.

[0058] In sample 5 membrane-formation conditions, the magnetic tape was produced like the sample 1 except having made the maximum incident angle into 90 degrees.

[0059] Evaluation of the magnetic properties in the sample 1 produced as mentioned above - a sample 5 and a magnetic parametric performance was performed. Magnetic properties were measured using the sample oscillatory type magnetometer. In magnetic parametric performance measurement, the recording head used the MIG head with a 0.22 micrometer width of recording track [of gap lengths] of 86 micrometers. Measurement of a magnetic parametric performance was recorded on the record wavelength of 0.3 micrometers by the MIG head, and was performed by reproducing using a nickel-FeMR head with a width of recording track of 5 micrometers. With a nickel-FeMR head, they are Bst/2=200G-mum. In addition, whenever [of a magnetic tape and an MR head / relative] were measured as 1 m/min.

[0060] Moreover, it was related with the sample 1 - the sample 5, and the corrosion resistance in SO2 gas ambient atmosphere was evaluated. The corrosion resistance test saved the magnetic tape for 13 hours in 30 degrees C of atmospheric temperature, 80% of relative humidity, and SO2 gas-concentration ambient atmosphere of 0.5 ppm, and performed it by measuring the amount of magnetization before and behind preservation. It carried out by computing the rate of magnetization degradation as the evaluation approach according to the following formula.

[0061] Since the rate of rate (%) of magnetization degradation ={1-(amount of magnetization after trial)/(amount of magnetization before trial)} x100 magnetization degradation is computed by the above-mentioned formula, the corrosion resistance of a sample can be evaluated as a numeric value, and a value with lower corrosion not occurring will be shown. At this time, measurement of the amount of magnetization of a magnetic tape was performed using the sample oscillatory type magnetometer.

[0062] Furthermore, the configuration of the impression generated on the magnetic layer front face was measured about the sample 1 - the sample 5. The configuration of an impression was performed using the atomic force microscope (AFM) about the sample before forming a protective coat, and identified the impression from the profile of a horizontal ****** cross section.

[0063] These results are shown in Table 1.

[0064]

[Table 1]

	最小入射角	最大入射角	Mr･t (mA)	保磁力 (kA／m)	再生出力 (dB)	媒体ノイズ (dB)	くぼみ深さ (nm)	幅／深さ w／d	磁化劣化率 (%)
サンプル1	70°	45°	22.4	102.7	0.3	−3.0	5.8	7.9	23
サンプル2	75°	45°	24.4	100.7	−0.2	−2.2	6.6	9.1	55
サンプル3	60°	45°	20.2	98.5	−2.8	−3.4	4.2	10.2	15
サンプル4	80°	45°	27.2	101.1	−0.9	−0.5	13.0	5.0	90
サンプル5	90°	45°	30.5	109.7	0(基準)	0(基準)	25.0	4.5	100

[0065] Since the depth of the impression formed in a magnetic layer front face became smallness as the maximum incident angle became small and the value of w/d became

large when the coercive force of a magnetic layer was adjusted so that it may become 100 kA/m extent as shown in Table 1, and the maximum incident angle became 75 degrees or less (a sample 1 - sample 3), it turned out that the configuration of an impression is loose. Consequently, if the maximum incident angle becomes 75 degrees or less, corrosion resistance is improved dramatically.

[0066] However, although corrosion resistance is excellent when the maximum incident angle is lowered to 60 degrees (sample 3), the playback output has deteriorated as a result of degradation of magnetic properties of a magnetic layer. Therefore, the maximum incident angle is understood that it is desirable that it is the range of 65 degrees - 75 degrees.

[0067] Moreover, it turned out that a magnetic-recording medium can set the value of Mr-t of a magnetic layer to 26mA or less by forming a magnetic layer for the maximum incident angle as range of 65 degrees - 75 degrees, and it becomes a thing suitable for the regeneration system using an MR head.

[0068]

[Effect of the Invention] Since the amount Mr of residual magnetization of a magnetic layer and the value of product Mr-t of Thickness t are optimized in this invention according to the property of MR reproducing head so that clearly also from the above explanation, the saturation of MR component can be prevented and high power and a low noise can be realized.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the important section sectional view of the magnetic-recording medium shown as an example of this invention.

[Drawing 2] It is the outline block diagram of the vacuum evaporationo equipment used for the manufacture approach of the magnetic-recording medium concerning this invention.

[Description of Notations]

1 Nonmagnetic Base Material, 2 Magnetic Layer, 3 Protective Layer